

An in-depth look at Deep Frying

The oil and shortening used for frying is an expensive material and worth looking after carefully if it is to give long frying life.

This brochure has set out the basic rules and principles of deep-frying – many of them are obvious and all are important.

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The Past and Future for Oils and Fats

The origins of the use of fats and oils are lost to history with the first references being made as early as 1600 BC when the Egyptians discovered that when pots containing animal fats were heated they provided a method of cooking without the need for water or direct roasting.

After the discovery of frying on a surface the use of large vats of oil for deep-frying was probably just a natural development. Indeed the Romans referred to the process as “boiling in oil”. This became a defensive method of combat when boiling oil was cascaded over castle walls in an attempt to cook the enemy.

The first recorded production of Potato Crisps (or Chips in USA) was as a result of a complaint by a certain Commodore Cornelius Vanderbilt in Saratoga Springs in 1853.

He complained that the potato slices fried for him were too thick and uncooked and requested the cook prepare them again. The cook being of a somewhat contentious nature sliced the potato so thin that when it was removed from the oil the potato was so well cooked it was completely crisp. The Cook, Mr. George Crum never expected the response, which, instead of being a further complaint, was a request for more to be provided to the other diners in the restaurant. Thus was born the Saratoga Chip, which has since become the fastest selling ‘out of bag’ savoury snack in the world.

The development of the deep fat fryer soon progressed and has now become the most popular method of fast food production with the catering industry.

Frying is a fast cooking method, which requires little or no preparation of the food save for the provision of a uniform portion, application of a batter and addition to hot oil. Consistent, high quality fried food can be produced with remarkable reproducibility.

The sale of pre cooked and ready to eat products involving the use of deep-frying has increased dramatically in the Western world and is rapidly expanding throughout the developing world. This is confirmed by the fact that edible oils are becoming commodities where the future indicates a shortfall of demand against supply if oil planting is not increased or the yield per hectare is not improved dramatically.

The conservation of oil used in the market will become a more important factor in cost control as the supply and demand relationship favours the supplier with a resultant increase in price anticipated. The extension in the useful life of deep frying oil will be the single biggest factor to ease the supply tightness. The use of Good Frying Practices will provide sufficient extension of the life of oil to provide a useful life of 2-4 times if adhered to in the processing of deep-fried products.

Many complex reactions occur during the frying process. These can be classified in to three main areas.

Oxidation – Caused by the reaction of oxygen with the hot oil and the catalytic reaction of positively charged particles on triglycerides.

Polymerisation- A catalytically driven reaction of the oil and its degradation products to produce large molecules of polymeric proportions.

Hydrolysis- Reaction of water or other components containing an OH group (can be Alkaline or Acidic Hydrolysis)

All of the above reactions have a deterioration effect on the quality of the oil however some may be viewed as conditioning reactions which imbibe a particular flavour or colour to the food. Others are very undesirable from the perspective of flavour, nutrition and toxicology.

Because of the complexity of the deterioration, a universally accepted, quantifiable and economically justified end point of the useful life of oil cannot be agreed upon.

The unacceptability of fried food is an obvious end point particularly in food service preparation. This can be improved by the use of Good Frying Practices and indeed the end point can be delayed significantly. The amount of total polar products in the frying oil shows the best correlation between the food quality and frying oil degradation. The amount of polar products formed can be reduced dramatically by filtration of catalytic reagents and food debris.

The current universal agreement among nutritionists is that the diets of developed countries are too high in fats and should be reduced. Fried food and frying has long been considered a significant contributor to diet and has also been held responsible for the intake of high calorific foods. In addition deep-frying requires the use of stable oils which in general indicates a degree of saturation, this is also being targeted as an area where reduction is seen as advisable. Even though the nutritional advice is contrary to the eating habits of the developing world, the use of fried food in the fast food sector continues to grow rapidly.

A major nutritional concern has been whether or not the degradation products of frying have significant physiological effects. This does not appear to be of current concern however the general consensus in the catering and scientific world is that the breakdown products of oil in normal frying and the low level of breakdown in products has no adverse effects. In some countries the oils and fats are tested in the field. Criteria for discard are based, for example, on the level of polar compounds. This is more directed towards a definition as what constitutes Good Frying Practices rather than the adverse physiological effects.

Future regulations for the discard of edible oils used in the European catering industry will probably surface within the next five to ten years. The exact criteria will, have no doubt, be debated strongly as, whatever the decision is, it will most certainly be accepted by the US unilaterally.

In the area of disposal of spent oils and grease trap residues, strict regulation has been imposed and producers of waste products are controlled in the industry with legislation. The same now applies for the catering industry as it is estimated that 50% of all edible oil disposed is generated in the catering type frying industry. Strict controls are now in place in the disposal of waste material and the regulatory authorities control the waste at the recycling site operated. Government authority regulates the disposal of waste oil generated in the catering industry. Any method, which reduces the need for oil disposal can only be, considered an advantage. The use of Good Frying Practices, oil management, and fryer management are three cardinal areas for action. All the more need for an integrated oil management service such as **FiltaFry**.

Why Fry?

Deep-frying is a most useful method of cooking foods for FIVE main reasons:

- (a) Because of the short cooking period, it is possible to prepare food as it is ordered; in this way, waste is kept to a minimum.
- (b) In deep-frying, the food is immersed in a very hot medium which sears and seals the food, keeping in more flavour than by other methods of cooking.
- (c) It is a fast method of cooking and most foods can be cooked in less than five minutes.
- (d) The layer of fat or oil deposited on the food during frying improves the eating quality of the food. Frying also imparts a characteristic flavour, which is different to that obtained by other methods of cooking.
- (e) Mouth feel is a very important factor in the presentation of food. The crispy or crunchy characteristic of fried foods increases the appeal to the consumer.

General Rules of Frying

- (a) Never heat the oil above 185°C (365°F) or it will spoil more rapidly. Use a thermostat or thermometer and regularly check them for accuracy. Regulate the temperature of the oil as carefully as possible, avoiding hot spots and high flames. Frying at too low a temperature will result in greasy products and an excessive absorption of oil by the food.
- (b) Fry the food in the correct amount of oil. The general rule is to fry one part of food in six parts of oil. If too much food is immersed, the temperature of the oil will drop and the food will be greasy. If too little food is immersed, the amount of oil needed to top up the vat becomes small and the main bulk of the oil will spoil more rapidly.
- (c) Choose the right medium for the job. Shortenings should be treated more carefully during melting down and topping up. Temperatures should not exceed 93°C (200°F) during the Meltdown of shortening. Once melted, the shortening can be heated to normal frying temperature.
- (d) Prepare the food carefully, ensuring that it is as dry as possible before frying. Wet foods, particularly potatoes, tend to make the oil froth and break down. This is unsafe and wasteful. Fragile foods must be handled carefully to avoid break-up during frying. If one of the proprietary materials for keeping potatoes white is used, the manufacturer's instructions should be followed.
- (e) Clean the oil regularly by skimming at the end of each day, to remove the small piece of burnt food which might accumulate. Clean the equipment by scrubbing with an approved cleaner and avoid the use of water wherever possible this should be completed at least once per week. Remove all residues from the fryer as any remaining cleaning residues or products of the cleaning process will cause catalytic degradation of the oil. Do not use iron, mild steel or copper strainers and utensils, as these metals accelerate the breakdown of any oil.

Temperature Control

Accurate control of temperature is essential and is best achieved either by the use of a thermostat or by the regular use of a thermometer. It is also important to check the accuracy of the thermostats and thermometers themselves from time to time.

Heating a shortening or oil past the normal frying temperature of 185°C (365°F) greatly increases its tendency to oxidise and is one of the most important factors governing the life of an oil. The higher the temperature of a shortening or oil, the quicker it will begin to deteriorate. On frying equipment where gas flames are used, the flame must be adjusted so that it does not flare up around the sides of the frying vessel and never to a height above the surface of the oil because of the danger of fire. Hotspots are also dangerous and should be corrected.

If the frying temperature is too low, the resulting product is greasy because the surface of the food is not sealed rapidly enough on entering the frying medium. Low temperature frying will also result in an excessive absorption of oil by the food being used.

An important factor when considering the frying temperature is the relative amounts of frying medium to food being fried. When too small a quantity of oil is used in a vat, the sudden introduction of an excessive amount of food - at room temperature - will result in a large drop in temperature and the appearance of faults associated with low temperature frying. This is even more important in the case of frozen foods; for example, falls in temperature of 1-10°C (30-50°F) can occur when frozen fish pieces are immersed in hot oil. On the other hand, when too large a quantity of oil is used, only a small proportion of the oil is lost by absorption. Only a low rate of topping up is then required and, because regular topping up with fresh oil tends to damp down the rate of spoilage, the bulk of the oil in the vat deteriorates more rapidly.

The heat exchange efficiency of the fryer can be seriously impaired causing 'hot spots' if they are not kept clean and free of extraneous matter.

Choice of Frying Medium

Due to the nature of their composition, some oils and shortenings tend to be more sensitive to heat and spoil more rapidly than others do. It is safer to use the shortenings and oils, which have been designed for the purpose of frying.

When selecting a frying medium, there is a choice between shortening and liquid oil. Liquid oil is easier to handle, but may be more expensive than a solid shortening. It is sometimes essential to use solid shortening; for example, with donuts there is an additional process of sugaring carried out after frying. If liquid oils were used, it would be difficult to obtain sugar adhesion.

When heated, liquid oils move by convection and there is less danger of local overheating of oil in contact with the vat sides, bottom and heating elements. Shortening needs more care because until shortening has melted, no convection currents are set up. Unless the melting process is carried out using gentle heat, the portions of shortening in contact with elements and vat walls will be overheated. When melting out shortenings, therefore, the temperature should not exceed 93°C (200°F) and when topping up with shortening, it should be broken into small pieces before adding to the vat.

Price, stability, flavour and nutrition are other considerations. Frying oils and shortening often contain materials including silicones, anti-spattering agents and flavours. Of these, perhaps silicone is the most important as this additive is used to control foaming and extend frying life.

Preparing of Food for Deep Frying

There are three ways in which food may be prepared for deep-frying:
By breading, in batter or without breading or batter.

Breading

Breading adds to the rich golden brown colour of fried foods. In addition, breading prevents the absorption of an excessive amount of oil and helps to retain the natural flavours within the fried food. For best results, follow these directions for breading:

- (a) Prepare food to be fried in uniform sizes and dry thoroughly.
- (b) Dredge pieces in a sufficient amount of flour.
- (c) Dip the dredged pieces into the following egg wash:
 - 6 shelled eggs
 - 340g (12oz) milk or water
 - Beat eggs together with liquid
- (d) Roll pieces in fine breadcrumbs. Most meats and seafoods and all croquettes are usually breaded. Some vegetables such as tomatoes, turnips, carrots and beetroots may also be breaded.

Batter

There are some foods that do not lend themselves to breading. For those foods, batter is required. Here is a good all-purpose batter;

Batter mix recipe: Makes approximately 7 kg (2 gallons)

- 1814g (4lb) plain flour
- 454g (1lb) self-raising flour
- 5g (1 level teaspoon) bicarbonate soda
- 11g (2 teaspoons) salt
- 272g (1 cup) milk powder
- 2 eggs
- Water to mix

All foods to be deep-fried should be as dry as possible before immersion in hot oil. If foods, particularly potatoes, are fried too wet, there will be a tendency for the oil to froth and break down. This will result in a shorter life of the oil and will be unsafe. Fragile foods must be handled carefully to avoid break-up during frying and the accumulation of material at the bottom of the vat. This accumulation of material will accelerate shortening spoilage.

Chips and other potato products are often prepared in advance of requirements. It is well known that potatoes discolour and turn brown under these circumstances. There are several preparations on the market which stop this discoloration. Care should be taken not to use solutions, which are too strong. Soaking for too long or neglecting to drain carefully after treatment also tends to discolour frying oil more rapidly.

Tip: Remove excess breading and apply batter lightly, as pieces which fall off, will speed deterioration of your oil.

Frying Temperatures

Items	Temp (°C)	Temp (°F)	Time (mins)
Fish fresh	180	350	3-4
Fish frozen	180	350	5-6
Potato chips (frozen)	185	365	4-5
Potato chips (blanching)	170	340	4-5
Chicken pieces	170	340	6-8
Meat: chops, cutlets, fillets	180	350	3-5
Sausages	180	350	1-2
Croquettes	185	365	2-3
Onions & tomatoes	180	350	2-4
Apple rings	180	350	3-4
Seafood (crushed)	180	350	2-3
Fritters	185	365	3-5
Donuts	185	365	1.5-2

These temperatures and times are offered as a guide, but the actual conditions will vary slightly according to the equipment, the condition of the oil and the size of the pieces being fried.

How to Operate a Deep Fat Fryer Efficiently

1. Dry all foods as thoroughly as possible before frying them. Moisture tends to break down oil.
2. Prepare batters and breadings well in advance.
3. Cut food pieces to the same size so that the entire batch will be fried uniformly.
4. Use the smallest size fryer practical for the job. If possible, use a battery of fryers, reserving one for blanching potatoes, another for finishing them, another for seafood, poultry etc.
5. Pack fresh shortening firmly into the lower section of the fryer and around the heating coils to prevent air pockets.
6. Do not turn on heat until all shortening is in the fryer. Keep heat low while melting down the shortening.
7. Do not overload fryer. Maintain the proper load ratio at all times.
8. Make sure frying temperature is the correct one for the particular food being fried.
9. Keep oil clean while frying. Use a small kitchen strainer to take out crumbs and bits of food that float in the oil. Remove them before they burn and carbonise.
10. Do not sprinkle salt on food directly over the fryer or while food is still in the frying baskets.
11. Drain all foods thoroughly after frying. Use a wire screen for that purpose.
12. Maintain a high rate of oil turnover. Gauge consumption so that at least 20% new shortening will be added per day.
13. Reduce frying temperature when fryer is not in use.
14. Check the thermostat on fryer frequently with a frying thermometer.
15. Clean fryer often - daily if the load is heavy enough to warrant it.
16. Skim off oil every day or at the end of each shift.
17. Make one person responsible for the maintenance of the fryer. Give complete instructions on cleaning the fryer. Check periodically to see that job is fryer properly done.
18. Filter oil through an efficient filtration system at least once per week.

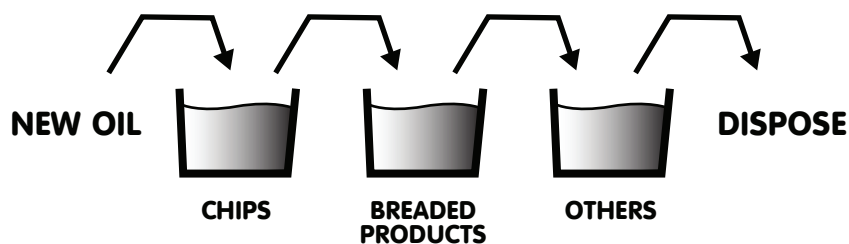
Filtration/Cleaning

Once an oil begins to deteriorate as a result of heating, the products which are formed tend to promote further deterioration and a chain reaction is set up. A good system of cleaning should be in operation to control this and this implies the regular cleaning of both the oil and the equipment.

The oil itself should be cleaned at the end of each day's frying by passing it through a fine mesh strainer to remove particles of food. If left in the vat, these particles will burn, accelerating decomposition and producing smoke and off flavours. A stainless steel mesh is preferable because some metals - notably copper and iron - increase the tendency of the oil to breakdown. It is recommended that the oil be filtered free of any small particles of contaminants at least once per week. These particles often comprise of microscopic carbon powder formed by the breakdown of food when fried for long periods of time. These are known to cause rapid breakdown of oils at high temperatures.

Rotation of fryers & topping up

1. Commence filtering oil from the fryer used for seafoods. Clean and dry this vat.
2. Filter next oil used for blanching, topping up seafood vat with filtered oil from the blanching vat. When the seafood fryer is filled to normal level switch flow of filtered oil to the holding tank.
3. Now clean the blanching vat; when clean and dry refill with filtered oil.
4. Now filter oil in the French fry cooker. Using this oil top up the branch fryer, excess being switched to the filtered oil holding tank. Repeat this procedure for each of the vats.
5. Finally, filter oil from the chicken fryer using filtered oil to top up the French fry cookers.
6. With **FRESH OIL** top up the chicken fryer. Thus, all fresh oil is used first for frying chickens, then French fries, then blanching and lastly, for seafoods.



Filtration

The best possible method of ensuring a long life for cooking oil is to filter the oil at least once per week. The procedure recommended is as follows:

1. Heat the oil to 185°C (365°F) maximum.
2. Call in your Filtafry Franchisee.
3. We recommend that you speak with your Filtafry Franchisee if you have any queries regarding filtration techniques.

Frying equipment must be emptied and cleaned once a week to avoid the build up of brown resinous polymeric material which is a natural breakdown product of oil. Cleaning must be affected by scrubbing with a suitable approved product and the use of water should be avoided wherever possible. Care must be taken where electric elements are located inside the vat, partly to avoid corrosion and partly to ensure that they are thoroughly cleaned. Whatever soap or detergent is used in the cleaning operation, it is essential to vacuum the vat thoroughly afterwards as soaps and alkaline materials greatly promote the breakdown of oil.

If the equipment is fitted with a fat trap, ensure that it is regularly cleaned to avoid odours and fire hazards.

Many systems have been evaluated for the filtration of cooking oils involving the use of filter aids where the cartridge filter has been unable to remove particles of less than 5 m. The Filtafry system achieves the better level of filtration without the need for additional aids.

It is almost impossible to determine the exact performance of any filtration in a frying system as a frying system performance varies from fryer to fryer. However it is true to say that the cost of improvement to oils and their lifetime is directly proportional to the level of improvement required. A system, which employs a filter aid as well as cartridges invariably, involves a higher cost.

Other variables such as type of food fried, amount fried / unit of oil, frying temperature all effects the rate of triglyceride degradation and thus frying oil quality.

‘The potential benefits of a good filtration system are improved food quality, oil life extension/reduced oil usage, reduced energy usage through improved heat transfer and labour reduction resulting from reduced fryer cleaning and fewer oil changes’

(An extract from a complete study of oil chemistry completed by the American Oil Chemist Society.)

This of course results in the reduced exposure of staff to hazardous materials and the associated risk of injury as well as the reduction of disposal of spent oils into the infrastructure and eventually into the environment.

Fat Absorption and Topping Up

Most operators top up the vat from time to time. As a general guide, the oil absorption of potato chips is usually about 10%. That is, 45 kg (100 lbs.) of potato chips will pick up 4.5 kg (10 lbs.) of oil from the vat. More porous foods such as donuts will absorb more oil than this and figures of up to 30% have been recorded. Oil absorption depends upon the time of frying (the longer the frying period, the greater the absorption), the total surface area of the food (the greater the area, the more the absorption), the nature of the food, the nature of the oil, and most importantly the temperature.

The general procedure in frying is to top up the oil as required. To some extent, the spoilage of the oil by heat is controlled or damped down by this process of continually adding fresh oil to the vat. It is important to use the optimum amount of oil for the weight of the food being fried, as this results in the best rate of topping up.

You'll prolong the life of your oil or shortening if you regularly top up the vat and employ Good Frying Practices. If you replace by topping up with at least 15% new oil or shortening each day, you may never have to discard 'old oil'.

If a vat holds 25-kg (55lb) of oil, add 5 kg (1lb) each day to top up. If you are not turning over your oil in about five days, maybe your fryer is too large for your volume of business.

We recommend a ratio of 1-kg (2 lbs.) of food to 6 k (14 lbs.) of oil. More food lowers the temperature of the oil... this food absorbs more oil.

Spoilage of Shortening and Oils

As a shortening is heated over a period of time, certain changes take place which are mainly caused by the effect of high temperature in the presence of air. Oil becomes darker in colour and more viscous. It will tend to froth, particularly when wet foods are fried in it. Smoke is more readily formed. Surfaces of the frying vessel become coated with a brown resinous material, which is difficult to remove.

Changes, which take place in oil, result in the production of objectionable smoke and odours. Fried food becomes more discoloured and distorted in shape and possesses a poorer flavour and greasier texture.

By the time oil is rejected, about one-fifth of it will have been altered by these breakdown processes. The frying life of oil will depend on the nature of the oil being used and the way in which it has been treated in the vat. Apart from the normal precautions which have been mentioned, the rate of breakdown of the oil is dependent on its exposure to the oxygen in the air. It is therefore dependent on the surface area of the oil exposed to air. The steam which is driven off from the food during frying tends to blanket the oil from oxygen. It can be concluded from this that it is better to keep the oil busily frying food as long as possible; an oil held at frying temperature but standing idle is more likely to deteriorate.

The signs of deterioration to watch for are a darkening in colour, a greater tendency for the oil to foam, a reduction in smoke point and impairment of flavour.

Many metals, mainly copper (and its alloys, such as brass) and iron, tend to accelerate the breakdown of a shortening and for this reason it is always better to use stainless steel. Some types of thermometer are made of brass and often domestic pieces of equipment, including strainers, ladles and containers, are made from the wrong metal. Brass drainage taps on equipment should also be avoided.

French frying of potatoes

Most varieties of potatoes are suitable for French-frying, although some varieties are preferred because of their size and shape. Whatever variety is used, the proper conditioning of the potatoes in advance of frying is most important. Here are a few simple suggestions for conditioning potatoes:

- (a) Keep a three-week supply of potatoes on hand, if possible.
- (b) Tag each lot of potatoes with the delivery date so that the oldest lot will be used first.
- (c) Store potatoes in a way that allows free circulation of air around the sacks. The ideal temperature for storing potatoes is 21-27°C (70-80°F).
- (d) Do not keep potatoes longer than three weeks if they are stored at 27°C (80°F) or above, otherwise sprouting and rotting will result.
- (e) Frozen chips are very popular these days because of their convenience and quality.

Preparation for frying

Potatoes should be peeled carefully and all eyes and dark spots removed. After cutting, wash potatoes in running water or soak them to remove the surface starch. If potatoes are not to be used immediately keep them in cold water. Dry potatoes thoroughly before frying.

Frying

There are two principal methods used to French fry potatoes; raw-to-done and blanch and brown.

- (a) **Raw-to-done:** There is little question that the best French-fried potatoes are those that are cooked from raw-to-done in one operation and served immediately. Raw-to-done should be fried only as needed, making sure, however, that the proper load ratio is maintained. The frying time will vary according to the variety and condition of the potatoes, but usually it will take about seven minutes at 185°C (365°F) using the 6 to 1 load ratio.
- (b) **Blanch and brown:** Preparing French fried potatoes by blanching is popular because it can be done in advance during, quiet periods. Blanching should be done at 177°C (350°F), using the 8 to 1 load ratio. The time required for blanching will vary from 4 to 6 minutes. Spread blanched potatoes thinly over absorbent paper or cloth. Avoid large heaps. If blanched potatoes are to be held for longer than two hours before browning, refrigerate them. Blanched potatoes should be brought to room temperature before browning.

General instructions

Do not salt potatoes while they are being fried. Salt breaks down frying oil. Do not re-fry potatoes that have been salted.

Finished potatoes should not be left in the fry basket and held directly over the fry vat. Heat will destroy their crispness. Drain potatoes immediately and spread them thinly over absorbent paper or cloth. Salt potatoes and serve at once.

French fried potatoes will remain hot for about 10 minutes after removal from the fry vat. After that they will be too cold to serve and should be discarded. French fried potatoes should be served hot. Do not reheat cold French fried potatoes in the fry vat.

Potatoes are usually cut about ½” thick for the more popular ‘French fries’. In addition, however, they may be cut to varying thicknesses and shapes to make shoestring potato chips.

Deep Fried Chicken

There are many methods used to deep fry chicken, but the two principal ones are the single-step and the pre-cook.

Since the single-step (raw to done in a single operation) is rarely used, this section will cover pre-cook methods only.

Pre-cook chickens may be prepared in advance by blanching, pressure-cooking, water cooking or pan-frying. Of these, here are two methods which we especially recommend.

- (a) Clean chickens and disjoint them. Place pieces on rack in a steam pressure cooker with a small amount of water. Add onion, celery, salt and other seasonings desired.
Salt chickens liberally.
- (b) Cook at 15-lbs./sq. inch pressure from 6 to 11 minutes (depending on size of pieces). Release valve and allow pieces to cool. Place them in refrigerator.
- (c) When ready to fry, bring pieces to room temperature. Dip them in the following batter:
 - 6g (1 tsp.) white pepper
 - 815g (3 cups) milk or water (var.)
 - 543g (2 cups) flour
 - 43g (2tbsp) salt
 - 87g (4tbsp) sugar

Or use Chicken Breading mix

Mix thoroughly to a smooth batter so thin that only a small amount will adhere to the pieces.

- (d) Fry immediately after dipping in batter at 185°C (365°F) until brown (about 3 minutes).

Blanching

- (a) Clean chickens and disjoint them. Salt pieces and pack them in ice for several hours or overnight.
- (b) Remove from ice and dry pieces thoroughly. Dredge in flour, salt and pepper.
- (c) Blanch pieces at 163°C (325°F) until cooked through (about 15 minutes).
- (d) Store pieces in refrigerator. When ready to fry, bring pieces to room temperature. Dip in above batter and fry at 185°C (365°F) for about 3 minutes.

Donuts

It has already been mentioned that the oil absorption of potato chips is of the order of 10%. Donuts absorb much more oil during frying; figures above 30% have been recorded and it has been shown that the shortening used for frying donuts discolours and smokes more readily than oil used for frying potato chips. It is necessary to be particularly careful when frying donuts; for example, it is preferable to rest or prove donuts on greased, rather than floured, surfaces because the flour will tend to fall off into the frying shortening and char.

Some of the factors influencing the amount of oil absorption have already been mentioned. One of the reasons why donuts have a higher absorption rate than chips is the more porous nature of the doughnut surface, but other points are of interest. In powder raised donuts, it appears that increased shortening and increased sugar in the recipe both result in more oil being absorbed during frying. The greater the surface area, the greater the absorption; cracks and rough surfaces increase the area and finger shapes and rings have more surface area than spheres. There is also evidence that oil absorption is decreased by warmer ingredients, longer mixing times and stronger flour, although each of these may also result in poorer eating qualities. It is always advisable to experiment before adopting a new method. Unless automatic equipment is being used, it is not easy to handle fully proved pieces of dough without damaging the structure.

The dough can be transferred to the fryer by means of an oiled palette knife and the fingertips. Yeast raised donuts should be placed in the frying medium upside down, this avoids the instability of the donuts during the second half of the frying process, after they have been turned over.

Many types of donuts are sugared after frying. For this reason, it is preferable to use a shortening as the frying medium, because sugar adhesion is better and the sugar does not discolour so readily. The flavour of the donut can be improved by adding a small quantity of cinnamon or mixed spice to the sugar. The donuts should be allowed to cool before sugaring, to prevent the formation of a wet, sodden coating caused by the steam escaping from the donut during cooling.

Fish

In frying frozen fish, the main point to bear in mind is that the sudden immersion of a quantity of very cold material into a frying oil is likely to reduce the temperature considerably. It depends on the type of frying equipment, what this effect will be. In fast recovery, automatically controlled vats, the temperature of the oil will return quickly to the correct point, while the food is being fried. In slower fryers and ones which are controlled by hand, the frying temperature may not recover in time and allowances must therefore be made when setting the temperature of the oil before the food is immersed.

Above 185°C (365°F), the frying oil will spoil more rapidly and if fish is fried at too high a temperature, the batter will cook too quickly and too hard, while the fish at the centre may remain relatively uncooked. If the temperature is too low, oil absorption will be greater and the food will be soft and greasy.

Foodstuffs Containing Fat

Precautions should be taken against contaminating the frying medium with other fats. Sausages, chicken, beef burgers and other meat products all contain various amounts of fat, which are still in their natural, 'unrefined' state. Clearly, these will tend to melt during the frying process, and their presence will lessen the life of the frying medium.

Transfer of food flavours

As long as frying is carried out at the correct temperatures, any food flavours which escape will be carried out of the frying medium with the steam. There is little danger that the oil will take up the flavour of foods being fried in it. It is therefore possible to fry a wide range of products without fear of contamination with other flavours. This is, of course, subject to the use of a high quality frying oil and Good Frying Practices. In the case of highly spiced or highly flavoured foods it is recommended to use separate vats for these products.

Guide to Deep Frying Problems

Foaming

Cause	Correction
Presence of soap or detergent residue from cleaning	Vacuum all debris from the fryer and rinse with small aliquots of fresh hot oil. Ensure fryer is perfectly dry before re-filling with oil
Excessive breakdown of oil	Filter oil weekly and use regular top ups. Replaced any oil considered spent.
Continual frying of food with excess moisture	Remove excess moisture from foods to be fried
Continued overheating of oil	Check setting of thermostat. Turn down heat when business is quiet to about 121°C (250°F)
Overloading fryer	Maintain 1-6 ratio of food to oil

Gumming

Cause	Correction
Heating oil too rapidly	When starting, melt oil gradually
'Hot spots' on heating tubes or elements	Check coils and tubes for 'thin walls' which cause hot spots
Continued overheating of oil	Check thermostat setting by using a thermometer
Frying oil broken down	Check amount of fresh oil added to fryer to be sure turnover is adequate
Using wrong cooking oil	Some oils form gums when used in deep fryer, e.g., sunflower oil/corn oil/Safflower

Greasy foods

Cause	Correction
Frying at low temperatures	Increase temperature and check thermostat setting
Inadequate preparation of food	Be sure foods (especially potatoes) are 'cured' correctly
Excessive quantities of breading or batter	Remove surplus breading or batter
Surplus moisture in and on surface of foods	Drain and dry foods before frying
Frying oil in advanced stages of breakdown	Discard 'exhausted' oil and recharge fryer. This exhausted oil will not serve as an adequate heat transfer medium
Use of dripping or other unrefined oils	Due to low smoke point, cooking in these oils at lower temperatures results in greater oil absorption by the food
Using the wrong kind of cooking oil	Always use a completely refined and deodorised cooking oil

Excessive oil usage

Cause	Correction
Too much oil is being absorbed by food being fried	Check setting of thermostat with a thermometer
Cooking at too low a temperature	Increase frying temperature (see Temperature guide: No.7)
Not draining after cooking	Make sure to drain food so that run off returns to fryer
Excessive heat breaking down of oil	Check temperatures constantly
Use of unrefined oils such as dripping	As these oils smoke at lower temperatures than refined and deodorised oils, food cooked at lower temperatures absorb more oil

Excessive usage is an indication of high absorption of oil in the food. This is a function of temperature and character of the food being fried - NOT due to the type of oil being used (unless unrefined oils are being used). Any variation in the apparent life of the oil is always due to one or more of the causes mentioned.

Rapid oil breakdown

Cause	Correction
Inadequate frying oil turnover	Adjust procedures to fry more food in fryer to increase turnover of oil
Overheating of oil	Check setting of thermostat with a thermometer
Contamination	Strain oil daily filter min weekly.
Poor cleaning procedures	Clean fryer each day or at least once a week. Dry fryer before use
Presence of copper or brass in frying equipment	Remove all copper or brass fittings from contact with oil
Overloading fryer	Maintain 1-6 ratio of food to frying oil
Excessive moisture on food	Drain and dry foods before frying
Overheating oil on standby	Reduce temperature of frying oil to 93°-121°C (200°- 250°F) during idle periods
Stack 'drip back'	Keep your flue clean

Darkening of oil

Cause	Correction
Presence of salt on food	Salt foods AFTER frying and away from fryer
Foods dipped in batter high in egg yolk	Reduce egg content of batter-replace part egg with milk
Oil contamination	Filter or strain oil daily
Poor cleaning practice	Clean fryer thoroughly at least once a week or each day in cases of heavy usage. Ensure fryer is perfectly dry before use
Overheating of oil	Check setting of thermostat with a thermometer
Insufficient oil turnover	Top up daily to replace contents of fryer every 3-5 days

Smoking

Cause	Correction
Insufficient turnover of oil	Maintain minimum quantity of oil in fryer for more rapid turnover or increase quantity of food fried in fryer. Filter oil weekly and top up fryer capacity by fresh oil every 3-5 days
Continual frying with excess moisture on food	Drain foods before frying, pat dry
Contamination of oil	Strain daily to remove contaminants. Filter weekly.
Poor cleaning practice	Clean fryer thoroughly at least once a week or each day in cases of heavy usage. Ensure fryer is perfectly dry before use
Overheating of oil	Check setting of thermostat with a thermometer
Rapid breakdown of oil	Rapid breakdown of oil
Use of unrefined oils	Dripping smokes at a lower temperature than refined and deodorised oils

Glossary

Here are some very simple definitions of a few common terms used when talking about shortening and frying:

Absorption:	The 'soaking up' of a frying shortening by the food fried in it. Absorption is affected by frying temperature and the type of food.
Breakdown:	Any chemical or physical change which occurs in the frying shortening-such as foaming, bad flavour, bad colour, smoking or gumming.
Foaming:	A persistent layer of bubbles which forms on the surface of the frying shortening during use. It is an indication of shortening breakdown.
Hydrolysis:	A chemical reaction that occurs between water and the frying shortening. It speeds breakdown of the shortening and is most pronounced in pressure frying kettle use.
Melting point:	There are many different tests that determine the speed and/or degree of melting. However, for simple frying applications, melting point is merely the temperature at which a solid shortening becomes liquid.
Off-flavour and/or odour:	Any flavour or odour that is not typical of either a particular frying shortening or the food being fried.
Oxidation:	The most common cause of shortening breakdown. It is a chemical reaction between oxygen and shortening
Smoke point:	The temperature at which the frying shortening will give a continuous column (or 'cloud') of smoke above the fryer while being heated.
Stability:	The ability of a frying shortening to resist chemical and/or physical changes.
Turnover:	The time required to completely replace the capacity of the frying kettle with new shortening. Shortening is used up by the absorption (or 'soaking up') of the shortening by the product being fried. A rapid turnover rate would be 2 days or less. Rapid turnover insures fresher shortening quality.



An In-Depth Look At Deep Frying.

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